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Low Scores in the Auto-Compliance Method and Fast Medical Care Influence the Poor Adherence in Diabetics attended in the Basic Health Unit

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Abstract

Objective: To evaluate the factors that influences the adherence in diabetics and correlate with the low and high Morisky Green Test (MGT) scores.

Subjects and methods: A total of 301 type 1 and type 2 diabetes patients aged 18 to 90 years using insulin and oral hypoglycemic agents were evaluated with instruments MGT, MedTaKe test (MT), Pharmacotherapy Complexity Index (CPI), Complication of Diabetes Index (CDI) and Auto-Compliance Test (ACT). The patients were divided into two groups: adherent diabetics with scores >80 in MGT and non-adherent diabetics with scores ≤ 80 in MGT, and their differences were compared with the student T-test and odds ratio with their respective confidence intervals.

Results: Significant differences were found in the variables: MGT (91.3 ± 8.5 vs. 59.2 ± 10, p<0.00), MT (62.5 ± 19 vs. 56.3 ± 21.6, p<0.01), ACT (94 ± 23 vs. 69.9 ± 44, p<0.00) of the adherent diabetics compared to the non-adherent diabetics. ACT (r=0.23, p<0.02), marital status (r=0.90, p<0.00), and race (r=0.94, p<0.00) were correlated positively with the >80 MGT scores, and schooling level (r=-0.15, p<0.03) was correlated negatively. For the non-adherent diabetics, the attendance service time (r=0.21, p<0.01), ACT (r=0.34, p<0.00), marital status (r=0.73, p<0.00), and CPI section two (r=0.18, p<0.04) were correlated positively, and drug loads (r=-0.18, p<0.04) was correlated negatively. Linear regression analysis showed that race (p<0.00) may influence the >80 MGT scores and attendance service time (p<0.01), marital status (p<0.00) and race influenced the ≤ 80 MGT group scores.

Conclusions: ACT, marital status, race and attendance service time may influence the low adherence in diabetics.

Keywords: Diabetes; Adherence; Insulin; Glycemic control; Pharmaceutical care

Introduction

To achieve optimal glycemic control in diabetes, patients are expected to test blood sugar, eat healthy food, have self-care behaviors, and when necessary take prescribed medications. In this baseline, adherence to medication in diabetes is crucial, and improving medication adherence in diabetics is a worldwide challenge. Poor glycemic control has been linked to the low adherence to medication and consequently the highest prevalence of non-controlled diabetics increasing the occurrence of negative clinical outcomes, such as hospitalizations and disease complications. Furthermore, it consumes 5-15% of annual health care budgets [1,2].

Nowadays, several studies have been carried in the worldwide for looking at medication adherence in diabetic patients [3,4]. Non-adherence is a multifactorial problem caused by factors related to the patient, the condition, type of therapy prescribed, the health system and socioeconomic factors. However, there are few studies in the Brazilian public health systems assessing, the effect of complexity of pharmacotherapy, added to the increase in the drug loads in the poor medication adherence in diabetic patients [5,6].

In the current health model, the physicians prescribe more medications or increase the dosage for achieving optimal glycemic control. Thus, an increase in the drug loads for the individual, high complexity of pharmacotherapy, and consequently a low adherence to treatment [7,8]. In this baseline, there are few studies in public health system currently evaluating the effect these variables with low or high scores of Morisky-Green Test (MGT). Thus, the objective of this study was to evaluate factors that influence the adherence in diabetics and correlate with the low or high MGT scores.

Materials and Methods

A cross-sectional study was performed in patients with type 1 diabetes (T1DM) and type 2 diabetes (T2DM) in the basic units of the public health system in Franca-SP, Brazil. Currently, the city of Franca has 342 thousand inhabitants, fourteen public health system units, five family health programs, as well as outpatient and specialty care units (Assistance Management Center, Adult and Infantile Mental Health Outpatient Clinic, Diabetic Care Home, Ophthalmology Center), DILC - Diagnostic Image and Laboratory Center, and ready-to-care

(Adult and Child Emergency, X-ray). The public health unit in the study had a mean monthly attendance of 350 people.

The STROBE Statement was followed in this study. The inclusion criteria were as follows: diabetic patients with T1DM and T2DM of genders from 18 to 90 years old, using NPH or Regular Insulin and oral hypoglycemic agents. All individuals attended in the basic health units between August and September 2016 was recruited. Clinical parameters such as fasting blood glucose, postprandial glycemia and glycated hemoglobin (HbA1c) of the last six months were collected from medical records. Patients without medical records of glycemic control levels were excluded.

A questionnaire consisting of open questions was applied to all patients by at trained pharmacist researcher. A pilot study was made for validation and standardization of the questionnaire on twenty patients to correct the difficulty of interpretation. These volunteers were excluded from analysis. The participant recruitment occurred as follows: patients were selected before medical consultation. Interviews were performed in a room separated from the doctor's office and the average time of each interview was 20 minutes. The variables collected through the questionnaire were age, gender, marital status, per capita income, schooling, comorbidities, time since diabetes diagnosis, number of drugs taken, consultation duration, waist circumference (WC), body mass index (BMI), drug loads, and levels of fasting blood glucose, postprandial glucose, and glycated hemoglobin.

To evaluate adherence to treatment, the patient's knowledge of the drugs in use, the complexity of pharmacotherapy, the complications of diabetes and the number of insulin injections missed, the following tests were applied: Complication of Diabetes Index (CDI), Auto-Compliance Test (ACT), MGT, MedTake test (MT) and CPI.

The MT is an instrument for assessing the knowledge of the patient about drugs taken. This test evaluates dosage (units), indication, regime, and knowledge about the drug-interaction or food-drug interaction of medications being taken. The MT scores are calculated for each drug as the percentage of correct actions and compared with label directions of medications. The MT has scores from 0 to 100% and the mean of all test scores for each patient is calculated, assessing the ability of subjects to take their drug safety. Patients who correctly answered correctly the four questions have a score of 100% and patients who answered only three questions receive a score of 75% [9].

The CPI is an instrument for assessing the effect of complexity of pharmacotherapy. This instrument is divided into three sections: A, B and C. The CPI is obtained by the sum of scores of the three sections. High section scores are defined as greater complexity [10].

The MGT is an instrument for assessing adherence to treatment. Six questions with Yes/No answers were included in the MGT: (1) Have you ever forgotten to take your medicine for diabetes? (2) At times, are you not careful about taking your medicine for diabetes? (3) When you feel better, do you sometimes stop taking your medicine? (4) At times, if you feel worse when you take your medicine, do you stop taking it? (5) Do you know the long-term benefits of taking your medicine? (6) At times do you forget to replace your medicine before it finishes? The patient only answers questions five and six if they answer yes to all of the questions one to four. The patients with scores of ≥ 80% in the MGT were considered as adherent [11].

The drug loads were calculated using the ATC/DDD system that serves as a tool for drug utilization research in order to improve the quality of drug use. The basis of this system is the presentation and comparison of drug consumption statistics at international and other levels. The dose of drugs that the patient was taking was divided by defining the daily dose according to international drug utilization research [12]. When the patient takes more of one drug, the ATC/DDD ratio values are increased. Patients with high values of drug loads have an overload in treatment and a high probability of developing adverse effects.

The CDI is an instrument composed of 17 questions for analyzing the complications related to diabetes. Thus, five questions, evaluate coronary heart disease, three questions for stroke, two questions for peripheral vascular disease, two questions for neuropathy, three questions about problems with the feet, and two questions for diabetic retinopathy. Each complication is determined by two or more questions, for example, coronary heart disease is present if the patient reported having a myocardial infarction, symptoms of angina pectoris, or having been diagnosed by a doctor. The CDI calculates the sum of any complications that are present, resulting in scores from 0 to 6 [13].

The ACT assesses the number of insulin injections missed in previous months. This method assesses the patient's self-reporting of the difficulty of applying the insulin by asking two open questions: (1) "Did you have any difficulties in insulin injection?" and (2) "How many times did you skip the insulin injection in the last month?" Auto compliance was calculated using the following formula:

Total number of insulin injections/Total number of prescribed insulin injections × 100

Considered as compliant with insulin were the patients who affirmed, taking more than 80% of the total number of prescribed insulin injections [14,15].

Ethics

The Research Ethics Committee of the School of Medicine of Ribeirão Preto, University of São Paulo has approved this study, protocol No.7724/2015 and release No. 2941 CEP/FMRP; ruling No. 049698/2015; CAEE45668815.9.0000.5440 (http://aplicacao.saude.gov.br/plataformabrasil/login.jsf). All individuals who met the inclusion criteria were invited to sign the Free and Informed Consent Terms.

Statistical Analysis

Patients were divided into two groups: adherent diabetics with MGT scores ≤ 80 and non-adherent diabetics with MGT scores >80 and their differences were compared with the student T-test (continuous variables), and odds ratio with their respective confidence intervals (categorical variables). The variables education (Table 1) and age (Table 2) were dichotomized.

The continuous variables are reported as means and s.d, and the categorical variables as frequencies and percentages. Analyzes were carried out using SPSS version 17.0. A 5% significance level was considered in all analysis.

Results

A total of 301 patients were evaluated in this study. The rate of adherent diabetics in the MGT>80 scores was 59% (178). In Table 1, the odds ratio was calculated for all categorical variables and there were no significant differences. In Table 2, there were significant differences in variables MGT (91.3 ± 8.5 vs. 59.2 ± 10, p<0.00), MT

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(62.5 ± 19 vs. 56.3 ± 21.6, p<0.01), and ACT (94 ± 23 vs. 69.9 ± 44, p<0.00) of the MGT>80 group compared to the MGT ≤ 80 scores.

Variables	≤ 80 MGT[a] (n=123)	>80 MGT[b] (n=178)	OR(CI)	P
Sex				
Male	58(47%)	69(39%)	1.4(0.88-2.24)	0.14
Female	65(53%)	109(61%)		
Race				
White	56(46%)	85(48%)	0.65(0.32-1.3)	0.25
Black	19(15%)	19(11%)		
Mixed	48(39%)	74(42%)	1.54(0.7-3.2)	0.24
Marital Status				
Married	61(50%)	100(56%)	0.76(0.4-1.2)	0.25
Single/Divorced	62(50%)	78(44%)		
Levels schooling(years)				
0-8	84(68%)	126(71%)	0.8(0.5-1.4)	0.64
09-12	39(32%)	52(29%)		
a= ≤ 80 Morisky-Green Test scores; b=>80 Morisky-Green Test scores				

Table 1: Sample characteristics with odds ratios and 95% confidence intervals.

There were significant differences in variables HbA1c (9.5 ± 2 vs. 8.6 ± 1.9, p<0.00), fasting blood glucose (178 ± 79 vs. 151.5 ± 67, p<0.00), and drug loads (2 ± 0 ± 0.90 vs. 0.91 ± 0.86, p<0.00) of the MGT ≤ 80 group compared to MGT>80 scores (Table 2).

Variables	≤ 80MGT[a] (n=123)	>80 MGT[b] (n=178)	CI	P
Morisky-Green Test	59.2 ± 10	91.3 ± 8.5	57.5-61[a] 90-92.6[b]	<0.00**
MedTake Test	56.3 ± 21.6	62.5 ± 19	52.5-60[a] 59-65[b]	<0.01*
CPI mean	19 ± 6.3	18 ± 5.8	18.3-20.6[a] 17-18.8[b]	0.34
CPI section 1	5.2 ± 0.92	5.1 ± 0.64	4.9-5.2[a] 5-5.3[b]	0.41
CPI section 2	9.7 ± 4.6	9.3 ± 4.4	8.9-10.5[a] 8.5-10.2[b]	0.55
CPI section 3	4.1 ± 1.8	3.9 ± 1.7	3.8-4.4[a] 3.6-4.2[b]	0.32
Complexity Diabetes Index	2.4 ± 1.39	2.1 ± 1.44	2.1-2.7[a] 1.9-2.4[b]	0.14
Hb1Ac	9.5 ± 2	8.6 ± 1.9	9.1-9.8[a] 8.3-8.9[b]	<0.00**
Postprandial Blood Glucose	235 ± 93	215 ± 96	219-252[a] 201-229[b]	0.07
Fasting blood glucose	178 ± 79	151.5 ± 67	165-193[a] 141-161[b]	<0.00**
Diagnostic Time (years)	16 ± 8	17.3 ± 9.7	14.8-17.8[a] 16-18.7[b]	0.31
Age(years)	59.5 ± 16	60.8 ± 13	56.7-62.3[a] 58.9-62.8[b]	0.47
Drugloads	2 ± 0 ± 0.90	0.91 ± 0.86	1.8-2.0[a] 0.8-1.0[b]	<0.00**
Number of medications taken	6 ± 2.7	5.8 ± 2.6	5-5-6.5[a] 5.4-6.2[b]	0.66
Number comorbidities	2.2 ± 0.8	2.4 ± 1	2.1-2.2[a] 2.3-2.6[b]	0.08
Service Time(minutes)	11 ± 4.9	10.8 ± 4	10-12[a] 10.2-11.4[b]	0.46
Auto Compliance Test	69.9 ± 44	94 ± 23	62-77[a] 91-97.5[b]	<0.00**
NPH Insulin Dosage (unit)	51.8 ± 24	49.6 ± 26	47-56[a] 46-53[b]	0.44
Regular Insulin Dosage (unit)	15.7 ± 10	14.7 ± 8	14-17.5[a] 13.5-15.9[b]	0.44
Metformin Dosage (mg)	658.5 ± 820	658.4 ± 1474	512-805[a] 440-876[b]	0.99
Per capita Income	562 ± 253	579 ± 248	517-607[a] 543-626[b]	0.56
Mean waist circumference(cm)	102 ± 13.5	101 ± 13.9	99-104[a] 100-104[b]	0.85
Female	101.4 ± 13.5	101.8 ± 13.4	98-104[a] 99-104[b]	0.87
Male	103 ±14.4	101.7 ± 13.7	98-105[a] 99.4-106[b]	0.63
Body mass index kg/m2	30.25 ± 7.1	30.24 ± 5.4	29-31.5[a] 29.4-31[b]	0.99
*p-value <0.05,**p-value<0.00				

Table 2: Samples characteristics.

In Table 3, the variables medical attendance service time (r=0.21, p<0.01), ACT (r=0.35, p<0.00), marital Status (r=0.73, p<0.00), and CPI section two (r=0.18, p<0.04) were correlated positively, and there was a negative correlation in the variable drugloads (r=-0.18, p<0.04) of the MGT ≤ 80 group scores. In the MGT>80 group scores there was a positive correlation with the variables ACT (r=0.23, p<0.02), marital Status (r=0.90, p<0.00), and race (r=0.95, p<0.00) and there was negative correlation with the variable schooling level (r=-0.15, p<0.03).

Variables	<80 MGT(n=123)[a] r (p-value)	≥80 MGT(n=178)[b] r (p-value)
Diagnostic Time	0.11(0.21)	0.12(0.87)
Age	0.17(0.53)	0.14(0.53)
Drugloads	-0.18(<0.04*)	-0.58(0.44)
Numberofmedicationstaken	0.08(0.35)	0.09(0.21)
TAM	0.21(<0.01*)	0.25(0.74)
Comorbidities	-0.08(0.36)	0.18(0.80)
Hb1Ac	-0.08(0.49)	-011(0.15)
Medtake	0.08(0.38)	0.09(0.19)
CPI mean	0.09(0.32)	0.03(0.68)

CPI section 1	0.01(0.83)	-0.38(0.62)
CPI section 2	0.18(<0.04)	0.09(0.22)
CPI section 3	-0.12(0.89)	-0.14(0.85)
Complications of Diabetes Index	0.05(0.56)	0.01(0.97)
Auto Compliance Test	0.35(<0.00**)	0.23(0.02*)
Schooling Level	0.07(0.93)	-0.15(0.03*)
Marital Status	0.73(<0.00**)	0.90(<0.00**)
Sex	-0.03(0.69)	-0.52(0.48)
Race	-0.48(0.60)	0.95(<0.00**)
*p-value < 0.05, **p-value<0.00		

Table 3: Correlations of MGT scores with the variables.

In Table 4, logistic regression analysis showed that medical attendance service time (p<0.00), marital status (p<0.00), and race (p<0.02) may influence the MGT ≤ 80 scores and for the MGT>80 group score only race (p<0.00) showed significant differences.

Variables	Estimate	Standard Error	Chi-square	P-Value
>80 MGT scores				
Diagnostic Time (years)	-0.03	0.03	-1.2	0.23
Age	0.21	0.21	1	0.31
Drug loads	0.27	0.21	0.85	0.39
Number of medications taken	-0.21	0.19	-1	0.28
TAM	0.12	0.61	0.2	0.83
Comorbidities	-0.13	0.14	-0.9	0.92
Hb1Ac(%)	-0.15	0.12	-0.11	0.9
MedTake	0.03	0.01	0.28	0.77
CPI mean	0.07	0.08	0.08	0.38
CPI section 1	-0.26	0.32	-0.81	0.41
CPI section 2	0.09	0.06	1.47	0.14
CPI section 3	-0.11	0.14	-0.83	0.4
CDI	0.26	0.19	1.4	0.16
Auto Compliance Test	0.06	0.2	0.32	0.74
Schooling Level	-0.21	0.57	-0.38	0.7
Marital Status	0.39	1.52	0.02	0.98
Race	8.54	0.96	10.74	<0.00**
≤ 80 MGT scores				
Hb1Ac(%)	-0.28	0.34	-0.08	0.41
Diagnostic Time (years)	0.06	0.62	0.83	0.4
Age	0.66	0.6	1.1	0.27
Drug loads	-1.2	0.8	-1.5	0.12
Number of medications taken	-0.51	0.58	-0.88	0.38
TAM	0.37	0.15	2.4	<0.01*
Comorbidities	-0.1	1.45	-0.69	0.94
MedTake	0.03	0.39	0.8	0.38
CPI mean	0.3	0.22	1.35	0.17
CPI section 1	1.04	0.88	-2.29	0.29
CPI section 2	0.25	0.22	-1.16	0.25
CPI section 3	0.15	0.56	0.27	0.78
CDI	-0.48	0.6	-0.8	0.42
Auto Compliance Test	-0.38	0.01	-0.33	0.73
Schooling Level	2.32	1.77	1.3	0.19
Marital Status	12.86	1.6	8	<0.00**
Race	-1.76	0.79	-2.2	<0.02
Gender	0.4	1.47	0.27	0.78
Postprandial glucose	-0.1	0.08	-1.23	0.22
Fasting blood glucose	0.08	0.1	0.76	0.46
TAM=Time under medical assistance; CPI=Complexity of pharmacotherapy Index; CDI= Complications of Diabetes Index,				
*p-value <0.05, **p-value<0.00				

Table 4: Results of logistic regression analysis of predictor variables in MGT scores.

In Table 5 the most missed questions in the MGT in the group of non-adherent diabetics were: questions one, two, three, five and six. In the group of adherent diabetics, the most missed questions were question one and question two.

Morisky-Green	≤ 80 MGT(n=123)	>80 MGT(n=178)
(1)Do you ever forget to take your medicine for Diabetes?	85	18
(2)Are you careless at times about taking your medicine for Diabetes?	93	69
(3)When you feel better, do you sometimes stop taking your medicine?	23	0
(4)Sometimes, if you feel worse after you take the medicine, do you stop taking it?	10	3
(5)Do yknow the long-term benefits of taking your medicine?	60	1
(6)Sometimes, do you forget to replace your medicine before it finishes?	24	4

Table 5: Most wrong questions by patients in the Morisky-Green test.

Discussion

We believe that ours is the first cross-sectional study to evaluate the factors that influence the adherence in diabetics and correlates with the poor scores and high MGT in diabetics attended by the public health system. Different from others studies in the literature, our findings highlight that it is impossible to control diabetes with faster medical care (less than twelve minutes), where the doctor only changes the prescription or increases the dose of the medicine. Besides that, our findings showed that lower ACT scores, marital status, race, and attendance service time may influence the low adherence in diabetics. The low ACT scores (69.9 ± 44 vs. 94 ± 23, p<0.00) compared to the MGT>80 group, showed that the diabetic patients ignored more numbers of insulin injections in the previous month and consequently this fact may influence the poor glycemic control and poor adherence.

Comparing our findings with the literature, unexpectedly one study performed in 2014 showed that almost all patients were adherent by the ACT, however, this fact might be partly due to overestimated medication adherence by the ACT [14]. Our study had more women than men in both groups and a large international data set showed that men have better control of diabetes compared to women [16]. Indeed, women with a low education level, long disease duration, insulin use, lack of education of diabetes and obesity, had the strongest association for poor glycemic control [17]. In Table 2 it is noteworthy that both WC and BMI of women and men are above the recommended by guidelines. Consequently, the weight gain associated with anti-diabetes medications may increase cardiovascular risk and reduce adherence to therapy [18].

The group MGT>80 there were more people married (100 vs. 61) compared to group MGT ≤ 80 (Table 1). Married people have better control of diabetes compared to the singles, divorced and widowed because the husband or wife may help with reminders of taking the medicines [19]. The racial/ethnic disparities may be influenced by the schooling level in the Brazil. In our study, the white patients had more years of study compared to the black and mixed race patients. Although we found associated with the race, low health literacy and medication adherence are more prevalent in racial/ethnic minority groups than white, but the racial/ethnic disparities in diabetes are conflicting. Black diabetic people have a higher burden of diabetes in the population [20]. In this sense, a retrospective cohort study showed that the medication adherence rate was higher for whites as compared to African Americans and the adherence rate of African American patients was lower by 12% compared to whites [21]. Recently, one cohort of black and white patients treated with oral medication showed medication adherence failed to explain observed racial differences in the achievement of HbA1c, LDL-C, and SBP control in diabetics [22].

Adherence in the MGT>80 group may have been influenced by the high number of men (69 vs. 58), high number married people (100 vs. 61), high scores in the MT (62.5 ± 19 vs. 56.3 ± 21.6, p<0.00), ACT (94 ± 23 vs. 69.9 ± 44, p<0.00) and low drug loads (0.91 ± 0.86 vs. 2 ± 0 ± 0.90, p<0.00). Furthermore, the positive correlations in the ACT (r=0.23, p<0.02), marital status (r=0.90, p<0.00), race (r=0.95, p<0.00) and negative correlation in schooling levels (r=-0.15, p<0.03) may also have influenced the adherence. The self-reported medication adherence was suboptimal for 59% of patients with diabetes, prescribed with either oral medication or with insulin. The most frequently endorsed reasons for non-adherence were forgetting (85%), carelessness (93%) and lack of knowledge (60%) of the long-term benefits for of taking their medicine. Aikens and Piette reported in 2013 that each one unit increase in the MGT (range 0-4) was associated with a 1.8 mmol/mol (0.16%) increase in HbA1c and difficulty remembering to take medication was associated with a 4.7 mmol/mol (or 0.43% unit) increase in HbA1c [23]. Added to this, the positive correlations of section two of CPI (r=0.18, p<0.04), the section that analyzes the frequency of daily dosage, the attendance service time (r=0.21, p<0.01), and drug loads (r=-0.18, p<0.04) may have influenced the low adherence in diabetics.

The NPH insulin dosage of both groups is above [12] the recommended guidelines (Table 2). Furthermore, the increase of NPH or Regular insulin dosages induced weight gain [18]. Ten patients of the adherent group and six of the non-adherent group are taking metformin above the recommended dosage. In this sense, our group showed that increasing the dosage of medications for treatment of diabetes without analyzing other factors linked with the progression and development of the disease does not resolve the problem.

Glycated hemoglobin levels of both groups were above the recommended by guidelines independent of high scores in the MGT of the adherent group. Diabetic patients with disease duration near to 10 years do not achieve target for HbA1c. A retrospective cohort study in Brazil reported that patients with T1DM and T2DM did not achieve targets for HbA1c [24,25]. It is noteworthy that control of diabetes in the public health systems has been badly performed and there is a need for changes in the care plan and national policies for diabetes management. Unfortunately, this is the picture of the Brazilian public health system, thus no non-pharmacological intervention is performed and the burden is attributed only to the medicines to control diabetes. In this baseline, pharmaceutical care comes as a powerful tool to control glycemic levels and improves the adherence to treatment in patients with chronic diseases including diabetes [26-30]. Recently our group published two review articles that showed that a change in the current medical model is needed and to investigate other factors such as toxins, malnutrition, stress, infections and electromagnetic pollution in patients with chronic diseases [26,31].

This study had some limitations. Our study was conducted in a single service, so the generalization of data should be performed with caution. As such, self-reporting generally tends to yield inflated adherence estimates, actual medication adherence was probably somewhat lower than we observed. Self-reporting has been criticized as an excessively subjective and upwardly-biased approach to estimating regimen adherence but the findings of Aikens and Piette strengthen their use in handling the diabetic patient [23].

Conclusion

Our findings showed that the lower ACT scores, marital status, race and fast medical care influence the low adherence in diabetics and may be influential in affecting glycemic control. Adherence strategies focused on reducing forgetting, carelessness, increasing the knowledge of diabetic patients about the disease or medicines and regimen simplification should be stimulated in the future. Additional validated tests such as the MGT, motivational interviewing, and daily mobile messages should be incorporated into the clinical management of patients with diabetes.

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Competing Interests

The authors declare no conflict interest.

Author Contributions

Study conception and design: HAP, MCFF, LRLP. Data collection: HAP. Data analysis: HAP MCFF, LRLP. Writing the paper: HAP, MCFF, LRLP. Supervision of the study: MCFF.

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